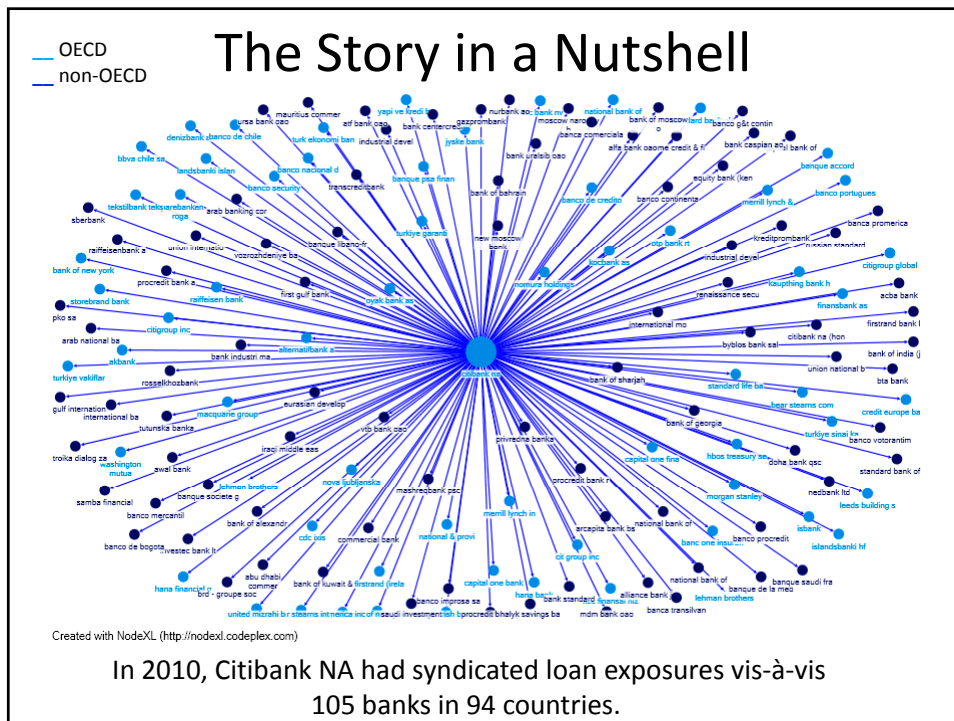# Channels of Crisis Transmission in the Global Banking Network

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*The views expressed herein are those of the authors and should not be attributed
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The Story in a Nutshell

Created with NodeXL (http://nodexl.codeplex.com)

In 2010, Citibank NA had syndicated loan exposures vis-à-vis
105 banks in 94 countries.

Motivation

- Complexity of financial linkages has been on the increase and raises questions about stability of global financial system during crises

- Financial linkages, especially cross-border may act as conduits of financial sector shocks
  - Ongoing efforts on banking regulation

Question

- Study the role of cross-border bank linkages in the transmission of financial sector shocks worldwide

- Estimate the impact of exposures to borrowers in countries experiencing financial turmoil on bank profitability
  - Why?
    - Key dimension of banking system soundness
    - It predicts bank survival

Aim

- Disentangle the channels through which systemic banking crises are transmitted through the global interbank market:
    - Direct exposures
        - First-degree (1 step away) connections
    - Indirect exposures
        - Higher-degree (> than 1 step away) connections
    - Relative position in the network
        - "Key intermediaries"

Contribution

- First paper to use loan-level data to examine the transmission of financial sector shocks through the global interbank network
- Steps:
    1. Construct global interbank network (**EGBN**) (for a large number of banks ~**5,500 banks**)
    2. Compute bank-level measures of interconnectedness
    3. Relate these measures to bank profitability (~**2,000 banks** are linked to their financials during 1997-2010)

Hypotheses

- Theory: interconnectedness carries **both**
  - **Benefits**: diversification, shock diffusion **and**
  - **Risks**: facilitates transmission of shocks/contagion

- Bank linkages may play a different role during normal and crisis periods
  - **Normal times**: portfolio diversification concerns, search for yield, advantageous market position
  - **Crisis times**: direct losses and contagion

Formally

- Bank performance **Y** is affected by crises in its home country **C** and the performance of banks to which it is exposed (directly or indirectly)

$$Y_i = \alpha_i + \beta\,C_i + \gamma \sum_j Y_j E_{ij}\delta^{(s)}$$

network distance

liner decay factor

- Substituting for Y_j

$$Y_i = \alpha_i + \beta\,C_i + \bar{\alpha}\gamma \sum_j E_{ij} + \beta\gamma \sum_j C_j E_{ij} + \frac{\bar{\alpha}\gamma^2}{1-\gamma} \sum_j P_{ij} + \frac{\beta\gamma^2}{1-\gamma} \sum_j C_j P_{ij}$$

direct exposure

indirect exposure

… adding network measures

$$Y_i = \alpha_i + \beta C_i + \mu N_i + \nu N_i C_i + \gamma \sum_j Y_j E_{ij} \delta^{(s)}$$

network characteristics ("key intermediaries")

Expanding,

$$Y_i = \alpha_i + \beta C_i + \mu N_i + \nu N_i C_i + \bar{\alpha}\gamma \sum_j E_{ij} + \beta\gamma \sum_j C_j E_{ij} + \mu\gamma \sum_j N_j E_{ij} + \nu\gamma \sum_j N_j C_j E_{ij}$$

$$+ \frac{\bar{\alpha}\gamma^2}{1-\gamma} \sum_j P_{ij} + \frac{\beta\gamma^2}{1-\gamma} \sum_j C_j P_{ij} + \frac{\mu\gamma^2}{1-\gamma} \sum_j N_j P_{ij} + \frac{\nu\gamma^2}{1-\gamma} \sum_j N_j C_j P_{ij}.$$

statistically insignificant

Data Construction

- Loan-level data from syndicated loan market for 1990-2010 from Dealogic's *Loan Analytics*
  - Carefully clean up bank names, adjust for bank name changes, mergers and acquisitions, etc.
  - Split total loan volumes by bank (pro-rata)
  - Construct interbank exposures and hence the binary and weighted EGBN
- Balance sheet data from *Bankscope*
- Systemic banking crisis dates: *Laeven and Valencia* (2013)

Example: Syndicated loan to a British investment bank

Participating banks (15):
BayernLB; Bank of Montreal (London); Bank of Tokyo-Mitsubishi UFJ Ltd; Commerzbank International Luxembourg SA; Dresdner Kleinwort Wasserstein; HSH Nordbank AG (London); ING Bank NV; KBC; Lloyds TSB Bank plc; Mizuho Corporate Bank Ltd; Royal Bank of Scotland plc; SG Corporate & Investment Banking; Standard Chartered Bank; Sumitomo Mitsui Banking Corp Europe Ltd; Wachovia Bank NA
Nationalities (7):
Germany, UK, Japan, Luxembourg, Netherlands, Belgium, France

Borrower:
Investec Bank (UK) Ltd.

Industry: Private sector bank

Signing date: March 28, 2006

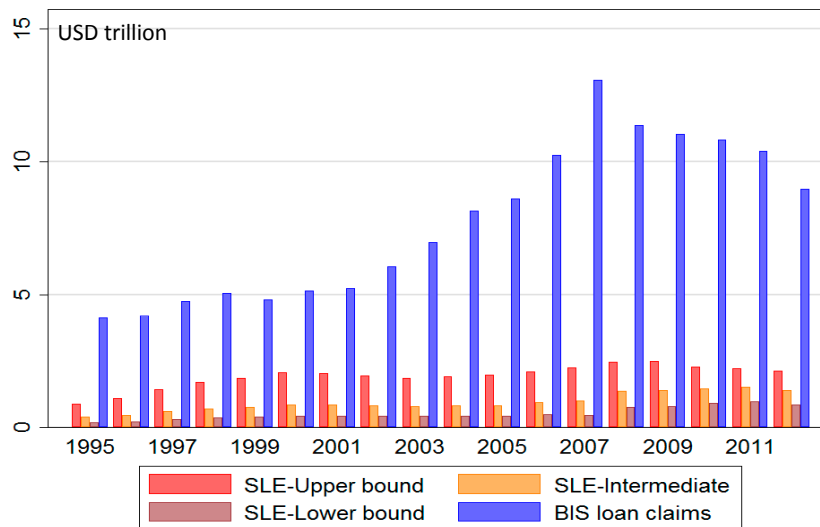**Deal type**: Investment grade

Maturity: 3 years

Amount: GBP 445 million

Interest rate: LIBOR + 120bps

Source: Loan Analytics

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Cross-border syndicated loan exposures = 12.5% of total loan interbank exposures, 1995-2012

USD trillion

SLE-Upper bound   SLE-Intermediate
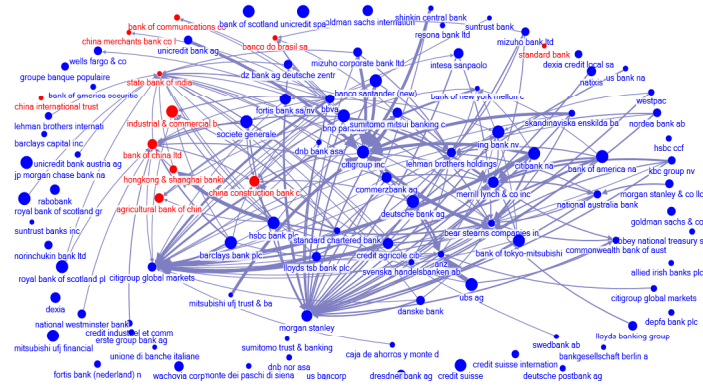SLE-Lower bound   BIS loan claims

Global Banking Network (EGBN)

Represents **Interbank Exposures** created through syndicated loan contracts

Constructed using the amounts and maturities of interbank loans

Relatively sparse

Visualization of the EGBN in 2007 for the largest 100 banks by assets. Blue: banks in OECD countries. Red: banks in non-OECD countries. Edge width proportional to size of syndicated loan exposures. Node size proportional to bank size.

Measures of Interconnectedness

1. **Direct exposures**
   - USD exposures (out-strength)
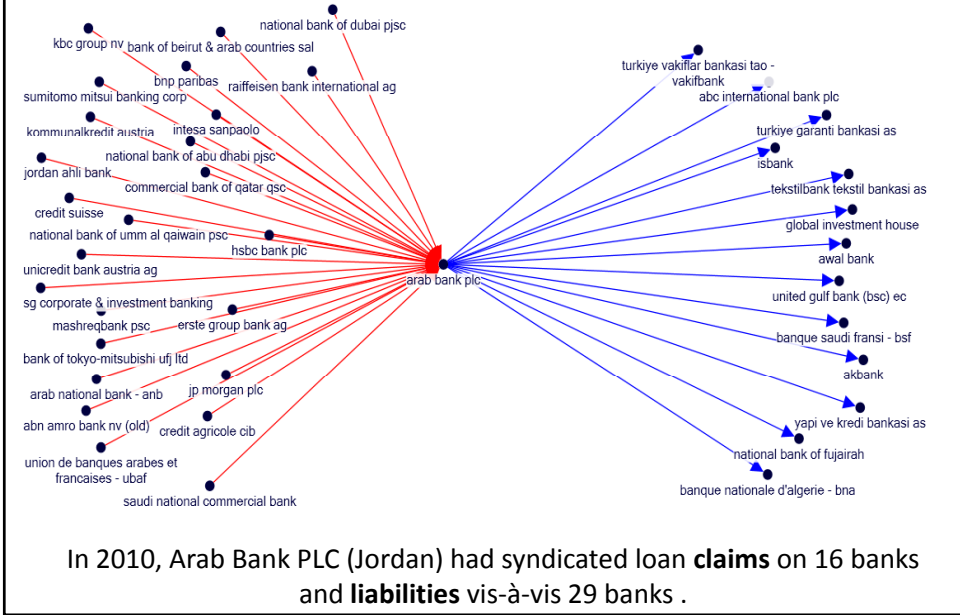   - Number of direct counterparties (out-degree)
2. **Indirect exposures**
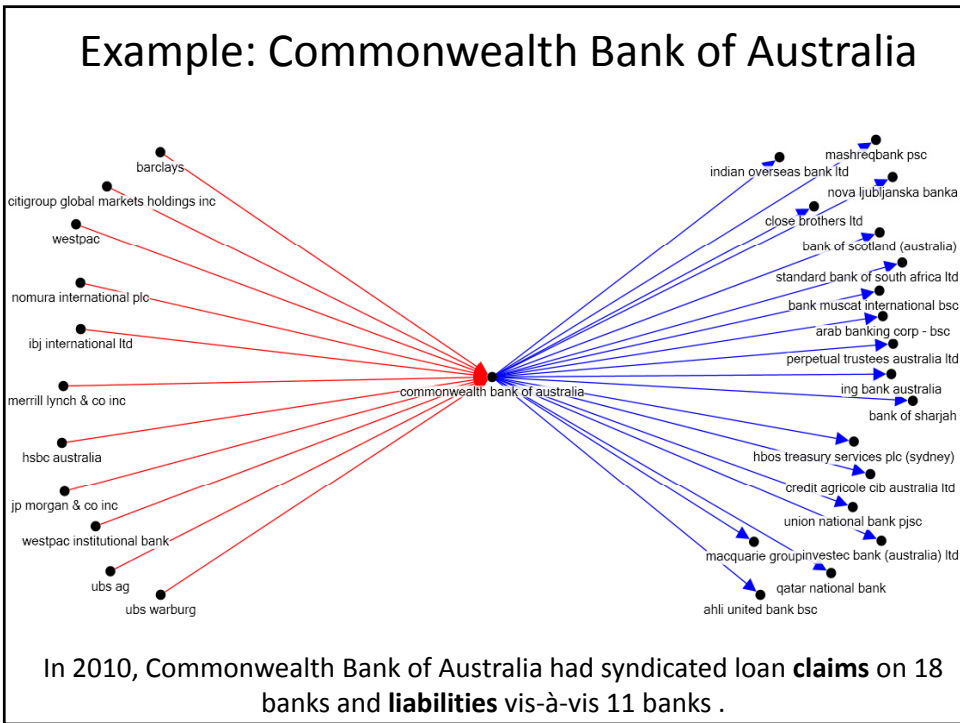   - Network proximity to the banks from each country (computed on binary EGBN)
3. **Relative position in the network ("key intermediary")**
   - **Betweenness Centrality**
   - Key intermediaries borrow from and lend to many other banks; they tend to "lie at the cross roads", to link groups of banks in the network (typically highly centric banks with peripheral banks)
   - Top EMs: China, Turkey, Russia, India, Brazil

Example: Arab Bank Plc (Jordan)

In 2010, Arab Bank PLC (Jordan) had syndicated loan **claims** on 16 banks and **liabilities** vis-à-vis 29 banks .

Example: Commonwealth Bank of Australia

In 2010, Commonwealth Bank of Australia had syndicated loan **claims** on 18 banks and **liabilities** vis-à-vis 11 banks .

Empirical Set-Up

Regressions

- Panel regressions:
  - Dataset: 2,000 banks from 88 countries over 1997-2010
  - Dependent variable: ROA
- Controls:
  - Bank size (log-assets)
  - Capital (equity/assets)
  - Indicator for crisis in bank's home country
  - Type of entity dummies
  - Specialization dummies
  - Bank nationality FE
  - Year FE
- St. errors clustered on bank

Main Covariates

- Direct exposures:
  - To banks and non-banks in crisis vs. non-crisis country-years
- Indirect exposures:
  - To banks in crisis vs. non-crisis country-years
- Relative network position
  - Dummy for key intermediaries
  - Interacted with crisis in the bank's home country and # crises elsewhere

Effect of Direct USD Exposures on ROA

	(1)	(2)	(3)
	ROA	ROA	ROA
Direct US$ non-crisis exposure (total)	-0.000		
	(0.000)		
Direct US$ crisis exposure (total)	-0.003***		
	(0.001)		
Direct US$ non-crisis exposure (banks)		-0.002	-0.003
		(0.002)	(0.004)
Direct US$ crisis exposure (banks)		-0.026***	-0.038**
		(0.008)	(0.015)
Direct US$ non-crisis exposure (non-banks)			0.000
			(0.001)
Direct US$ crisis exposure (non-banks)			0.002
			(0.003)
Observations	11,374	11,374	11,374
R-squared	0.336	0.336	0.336

Effect of Direct & Indirect Exposures on ROA

	(1)	(2)
	ROA	ROA
Direct US$ non-crisis exposure (total)	-0.000	-0.001
	(0.000)	(0.000)
Direct US$ crisis exposure (total)	0.002	0.002
	(0.002)	(0.002)
Direct 0-1 non-crisis exposure (banks)	0.000	-0.000
	(0.001)	(0.001)
Direct 0-1 crisis exposure (banks)	-0.019***	-0.016**
	(0.006)	(0.006)
Indirect 0-1 non-crisis exposure (banks)		0.106
		(0.171)
Indirect 0-1 crisis exposure (banks)		-0.820*
		(0.469)
Observations	9,552	9,063
R-squared	0.343	0.339

Potential mechanisms

- Two mechanisms:
  - Losses due to defaults (bankruptcies)
    - Syndicated loan market exhibits lower default rates and higher loan recovery rates than other segments of credit market (even more so for banks)
    - Typically, renegotiation to extend maturity
  - Losses in the securities portfolio
    - Only leveraged loans are traded (bank borrowers unlikely)
- Challenges:
  - Difficult to identify mechanisms using aggregate data
  - Syndicated loan exposures may be proxies for broader exposures to borrowers

Effect of Being Key Intermediary on Bank ROA

Dependent variable: ROA	(1)	(2)	(3)	(4)	(5)
	All	All	All	Top	Bottom
Direct US$ non-crisis exposure (total)	-0.001	-0.001	-0.001	-0.001	0.018
	(0.000)	(0.000)	(0.000)	(0.000)	(0.039)
Direct US$ crisis exposure (total)	0.001	0.001	0.001	0.003	-0.783**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.347)
Direct 0-1 non-crisis exposure (banks)	0.000	0.001	0.001	0.001	0.012
	(0.001)	(0.001)	(0.001)	(0.001)	(0.012)
Direct 0-1 crisis exposure (banks)	-0.014**	-0.017**	-0.016**	-0.013*	0.011
	(0.007)	(0.007)	(0.007)	(0.008)	(0.018)
Indirect 0-1 non-crisis exposure (banks)	0.100	0.089	0.085	0.284	-0.135
	(0.174)	(0.173)	(0.174)	(0.206)	(0.437)
Indirect 0-1 crisis exposure (banks)	-0.832	-0.801	-0.806	-0.290	-2.168***
	(0.549)	(0.552)	(0.551)	(0.690)	(0.573)
Key intermediary	-0.162***	-0.029	-0.010	-0.111	0.117
	(0.061)	(0.057)	(0.063)	(0.075)	(0.096)
Key intermediary * Crisis in home country		-0.535***	-0.517***	-0.012	-0.942***
		(0.157)	(0.159)	(0.123)	(0.239)
Key intermediary * No. of crises elsewhere			-0.003	0.001	-0.011
			(0.004)	(0.005)	(0.007)
Observations	8,734	8,734	8,734	2,866	4,715
R-squared	0.341	0.344	0.344	0.418	0.342

Conclusions

- Built a global interbank network from granular data on syndicated loans during 1997-2010
- Results:
  - Controlling for exposures to non-bank sector, direct and indirect exposures to banks reduce bank profitability during crisis-years
  - "Key intermediaries" (especially from EMs) perform worse than other banks during crises in home countries
- Ongoing work on potential mechanisms